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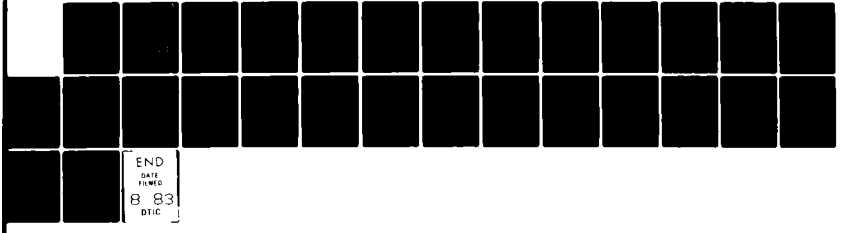

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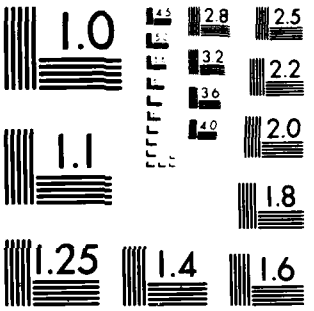

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This TOP prescribes methods for evaluating the durability and protective qualities of clothing developed for cold regions use. It contains procedures for evaluating wind, cold, and snow protection, physical, and thermal durability characteristics. It describes the necessary facilities and instrumentation requirements for test accomplishment.

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US ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURE

DRSTE-RP-702-109
*Test Operation Procedure 10-2-510 8 July 1983
AD NO.

# COLD REGIONS ENVIRONMENTAL PROTECTION AND DURABILITY TEST OF CLOTHING


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1. SCOPE. This Test Operations Procedure (TOP) details test procedures for evaluating the environmental protective capability and durability of clothing developed for cold regions use. A series of procedures is presented, designed to produce data to support an evaluation of the environmental protection and durability qualities of cold weather clothing.

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities.

2.1.1 A heated enclosure that is suitable for placing temperature measuring elements on personnel participating in the test.

2.1.2 A 100-meter course on relatively flat, smooth, and open terrain. The course will be of sufficient width to allow 12 test participants to traverse the course at the same time. The course will have a heated shelter at one end to house the temperature monitoring and recording instrumentation.

2.1.3 An area that can be used to fire the standard military rifle or simulated firing of the rifle. This area must be in a location that precludes snow from being blown off the course.

*This TOP supersedes TOP 10-2-510, 27 July 1981.

2.1.4 An obstacle course. A representative course is shown at appendix D.

2.2 Instrumentation. All instrumentation requiring calibration will be within their calibration period to assure that minimum accuracies can be obtained.

| Item | Range | Minimum Accuracy |
|---|---|---|
| Meteorological Instrumentation: | | |
| Thermometer | 25°C to -55°C (77°F to -67°F) | ±1°C (±1.8°F) |
| Hygrometer | 0 to 95% | ±5% |
| Wind Velocity | 0 to 35 Knots (40 mph) | ±3 kph (±2 mph) |
| Wind Direction | 0 to 360° | ±5° |
| Timer | 6 Hour | ±30 sec |
| Thermocouple or thermistor with monitor and recorder (portable) | 0°C to 40°C (32°F to 104°F) | ±1°C (±1.8°F) |
| Scale (weight) | 2 kg (4.9 lbs) | ±1 gm (±0.05 oz) |
| IR Scanner with photographic attachment | 2°C (3.6°F) Span Differential Temperature | ±0.2°C (±0.36°F) |
| Generator | 1 kw | NA |

2.3 Equipment. A truck with a platform on the front, capable of accommodating three men abreast, will be used to create windchill temperatures.

3. PREPARATION FOR TEST.

3.1 Facilities. Insure that the warm shelter is available at one end of the test course to house the temperature monitor and recorder, and that 60-cycle power is available in the shelter.

3.2 Equipment. Insure that equipment is available for use and a power source is available at the test site if applicable.

3.3 Test Item. All items of clothing including the test item will be examined before testing to insure they are clean and dry and that a unique identification number is permanently marked on each test item or set of test items. The locations of the identification number will be easily visible and consistent on all test items. A cleaning schedule shall be established for the test item. The cleaning procedure followed shall adhere to the cleaning instructions provided with the test item by the developer. In the absence of cleaning instructions normal procedures for cleaning like items in accordance with the applicable technical manuals shall be followed.

3.4 Instrumentation. Insure that the instrumentation listed in paragraph 2.2 is available, in operational condition, and calibrated. When required, thermocouples will be placed on the center of the instep (right) side and extending to the tip of the big toe on the left foot, the center of the throat, and at the tip of the smallest finger of the right hand of all test participants. In some cases an additional sensor may be required in the alimentary canal. Place other thermocouples on test participants according to the item to be tested as indicated by the following chart:

Head Protective Equipment
- Back of Neck
- Middle of the Forehead
- The Tip of the Nose
- Left Cheek

Upper Torso
- Center of Chest
- Center of Back, 3 inches below Shoulder Level
- Center of Stomach

Trousers
- Front of Thigh (right)
- Directly behind Left Knee

3.5 Data Required.

3.5.1 Meteorological Information. Temperature, relative humidity, wind velocity, wind direction, and overall weather observations.

3.5.2 Instrumentation. Type, nomenclature, accuracy, description, and serial number of each item of instrumentation.

3.5.3 Personnel Data. Record the name, anthropometric measurements, SSN, MOS, results of physical examination insofar as it reflects upon the individual's ability to participate in the test and a description of the duties of each test participant and include these data with the records for the appropriate test item.

3.5.4 Test Item. Type, size, general description, and physical condition of each test item; and total number of items to be tested.

3.6 Personnel.

3.6.1 Personnel whose duties represent a cross section of those tasks normally performed by military personnel will be selected as test participants. Test participants will be oriented in all aspects in the application and use of the test item.

3.6.2 Test participants will be briefed on the objective of the test, the procedures to be followed to accomplish the objective, the responsibility of each test participant during test conduct, and the approximate time required to complete the test.

3.6.3 All test participation will be voluntary if required by TECR 385-7 (ref 1, appendix C), and/or AR 70-25 (ref 2, appendix C), and each participant must be willing to sign privacy act release statements, if required.

4. TEST CONTROLS.

4.1 Before testing begins, each prospective participant will be examined by qualified medical personnel to verify they are in acceptable physical condition for performing the intended test activities. Those individuals with physical conditions that would bias the test results or endanger their health will not be used as test participants. Results of the medical examination will be a part of the privacy act release (AR 70-25, ref 2, appendix C).

4.2 If during testing, test participants are removed for medical reasons, they will undergo an immediate physical examination by a physician. The physician's report of the results of the examination, insofar as it reflects upon the ability of the individual to participate in the test, will be included in the test data. Results of the medical examination will be a part of the privacy act release (AR 70-25, ref 2, appendix C).

4.3 During testing, all participants will be dressed with the identical type and amount of standard issue clothing and the test item. The type and amount of clothing worn shall be appropriate to the prevalent weather condition.

4.4 All tests will be conducted within the temperature range for which the item is designed as determined from the requirements documents or the test directive. This temperature range will be divided into three equal divisions. At least one test will be conducted within the lower one-third of the lowest temperature range and one in the upper one-third of the highest temperature. If the item of clothing was designed for use in a particular temperature range, these temperatures will be emphasized.

4.5 If possible a minimum of a 12 test items will be used during each test. The personnel performing the tests shall be selected for proper fit of the test items.

4.6 During conduct of the test when the temperature of the extremities (finger, toe) drops to 10°C (50°F), the test participant will be removed from testing immediately and allowed to warm in a heated shelter.

4.7 Test participants shall have a minimum rest period of 10 minutes between tests.

4.8 Throughout testing, test participants will be observed for symptoms of cold injury. At the first symptoms, a test participant will be removed from testing, rewarmed, and, if necessary, examined by medical personnel.

4.9 At any phase of testing, if a test participant indicates unusual discomfort, he will be removed from testing and the cause of the discomfort will be investigated.

4.10 Test procedures and quantitative limits specified in this TOP are based upon typical test design for a broad range of cold weather protective clothing. Some items may require variations from these procedures to accommodate specific needs.

5. PERFORMANCE. The expected life of the test item shall be obtained from the requirements documents or the test sponsor. The test item shall be worn by test participants during appropriate weather and work conditions for the specified life of the item. Thermal protection and physical integrity will be evaluated separately. The test participants shall engage in their normal duties as well as perform specific tests as described in this TOP. A daily log of the usage time will be maintained. At the appropriate time interval, as determined by the type of item under test, all test items shall be cleaned and reissued to the original recipient.

5.1 Cold Protection. The cold protection qualities of the test item will be evaluated during the 6-hour tests. Two of these 6-hour tests will be conducted in the lower temperature range and two 6-hour tests will be conducted in the upper temperature range for which the item was designed. Items that fail the cold protection test at the lower temperature range will be tested in the lower one-third of the midtemperature range as calculated in paragraph 4.4. All testing will be conducted during wind velocities of less than 5 kph (3 mph).

5.1.1 Method.

5.1.1.1 Active. Test participants will spend 6 continuous hours outdoors performing this test. Test participants will make five round trips of a 100-meter course at a pace of 2 minutes per round trip. The temperature indicated by the thermocouples mounted on the test participants will be

monitored and recorded every 20 minutes. Test participants who experience cold discomfort or who experience a drop of the temperature of the extremities to 16°C (60°F), will have the temperature of their thermocouples recorded at 10-minute intervals until removed from testing. Testing will begin when the ambient air temperature reaches and is predicted to remain for the test period within the range that the test is to be conducted. Meteorological data will be recorded continuously throughout testing.

5.1.1.1.1 In a warm shelter (21°C, ±3°C), each test participant will don the test item and the additional standard issue clothing appropriate to the prevailing conditions. The temperature of the thermocouples of each test participant shall be recorded. The day's prior food and liquid intake (e.g., breakfast) of each participant will be recorded.

5.1.1.1.2 The test participants will go outside and walk 10 round trips of the test course at a pace of 2 minutes per round trip. The temperature of the thermocouples shall be monitored and recorded every 20 minutes or at the conclusion of the 10th, 20th, 30th, and 40th round trip.

5.1.1.1.3 At the end of 80 minutes or the conclusion of the 40th round trip, each test participant will be allowed a 10-minute break. This 10-minute break and each subsequent 10-minute break, shall be spent in the environment in which the test is being conducted. During this break, test participants may drink hot or cold liquids; however, the amount and type of liquid consumed by each test participant will be recorded. At the conclusion of the break, the temperatures of the thermocouples will be monitored and recorded.

5.1.1.1.4 At the conclusion of the 10-minute break, the test participants will resume walking the test course. The temperature of the thermocouples will be recorded at the conclusion of the 50th, 60th, 70th, and the 80th round trip of the test course. At the conclusion of the 80th round trip of the test course, the test participant will take a 10-minute break. The amount and type of liquid consumed by each test participant shall be recorded.

5.1.1.1.5 At the conclusion of the second 10-minute break, the temperatures of the thermocouples shall be monitored and recorded.

5.1.1.1.6 After the break, the test participants shall resume walking the test course. The temperature of the thermocouples shall be monitored and recorded at the conclusion of the 90th, 100th, 110th, and 120th round trip of the test course.

5.1.1.1.7 At the conclusion of the 80th round trip of the test course, the test participants shall take a 10-minute break. The type and amount of liquid consumed by each test participant shall be recorded.

5.1.1.1.8 At the conclusion of the 10-minute break, the test participants shall resume walking of the test course. At the conclusion of the 90th, 100th, 110th, and 120th round trip of the test course, the temperature of the thermocouples shall be monitored and recorded.

5.1.1.1.9 At the conclusion of the 120th round trip of the test course, the test participants shall be given a 10-minute break. The type and amount of liquid consumed by each test participant shall be recorded.

5.1.1.1.10 At the conclusion of the 10-minute break, the temperature of the thermocouples shall be monitored and recorded. The test participants shall then move to a warm shelter with a temperature of 21°C, ±3°C. The temperature of the thermocouples shall be monitored and recorded after an elapsed time of 10 minutes and 20 minutes in the warm shelter.

5.1.1.1.11 At the conclusion of 20 minutes in the warm shelter, test participants shall remove the test items and all instrumentation.

5.1.1.1.12 Each test participant will then be interviewed (appendix C) to obtain an individual subjective assessment of the test item's thermal qualities.

5.1.1.2 Inactive. Test participants shall spend 2 hours outside simulating standing guard duty performing a minimum of physical activity. The temperature indicated by the temperature sensing devices attached to the big toes will be recorded continuously throughout the test.

5.1.1.2.1 In a warm shelter (21°C, ±3°C) each test participant will don the test item and the standard issue clothing appropriate to the prevailing weather conditions. The temperature of the temperature sensing element will be recorded. The test participants shall then go outside and start the test insuring that all temperature sensing elements are connected to a recording device.

5.1.1.2.2 At the conclusion of 30 minutes testing, each test participant shall be scanned on four sides with the IR Scanner to locate areas of high heat loss. If significant high heat loss areas are located, the sensitivity of the IR Scanner shall be adjusted to obtain maximum temperature detail on the display unit. Photographs will be taken of the scanner display indicating the high temperature loss areas.

5.1.1.2.3 At the conclusion of 1 hour of testing repeat the test procedures of paragraph 5.1.1.2.2.

5.1.1.2.4 At the conclusion of 90 minutes of testing repeat the test procedures of paragraph 5.1.1.2.2.

5.1.1.2.5 At the conclusion of 2 hours of testing repeat the test procedures of paragraph 5.1.1.2.2. Test participants will then disconnect the

temperature sensing elements from the recorders and enter the warm shelter. The test item shall be worn for 20 minutes after entering the warm shelter. The temperature of the sensing elements shall be recorded at the conclusion of 10 minutes and 20 minutes in the warm shelter.

5.1.1.2.6 At the conclusion of 20 minutes in the warm shelter, the test item and all temperature sensing elements shall be removed. Each test participant shall then be interviewed to obtain an individual evaluation of the test item's thermal qualities.

5.1.2 Data Required.

Meteorological data
Thermocouple temperature and time of each measurement
Results of interview
Test participant's comments (including food and liquid intake)
Discontinued test (environmental related) attributable to problems in test item
Recorded observation of the test officer
IR Scanner photographs (if applicable)

5.2 Wind Protection. The wind protective qualities of the test item shall be evaluated in two 1-hour tests. The wind protection capabilities of the test item shall be evaluated at the lowest windchill temperatures for which the item is designed. If the test items are unsatisfactory at the designed windchill temperatures they will be retested at higher windchill temperatures at increasing increments of 10°C (18°F). Windchill temperatures will be determined from the charts contained in appendix E.

5.2.1 Method. Test participants will spend 1 continuous hour in the lowest windchill temperature for which test item is designed. The minimum wind velocities used to derive these windchill temperatures will be 32km/hr (20 mph). The windchill factors may be artificially induced by travel in an open conveyance without wind shielding. The temperature on the temperature sensors on each test participant will be monitored continuously.

5.2.1.1 In a warm shelter (21°C, ±3°C), each test participant will don the test item and the additional standard issue clothing appropriate to the prevailing conditions. The temperature of the temperature sensors on each test participant shall be recorded.

5.2.1.2 Immediately after leaving the warm shelter, test participants shall proceed to the test area and connect the temperature sensors to the recorders and begin testing.

5.2.1.3 After 1 hour of the test described in paragraph 5.2.1, the test participants shall disconnect the recording instrumentation and return to the warm shelter.

5.2.1.4 After returning to the warm shelter, test participants shall continue to wear the outside clothing ensemble for 20 minutes. The temperature of the thermocouples shall be recorded at the conclusion of 10-minute and 20-minute intervals.

5.2.1.5 After 20 minutes, test participants may remove the test item. Each test participant shall then be interviewed to obtain an individual subjective assessment of the test item's wind protective characteristics.

5.2.2 Data Required

Meteorological information
Windchill temperature factors
Thermocouple temperature
Number of tests discontinued because of cold and narrative description of cause
Recorded observations of the test officer

5.3 Snow Protection. The protective capabilities of the test item shall be evaluated from two 3-hour tests. One test shall be conducted within 15°C of the lowest temperature at which the test item is designed to be worn and one test will be conducted at temperatures between -3.9°C (25°F) and 4.5°C (40°F). Testing shall be performed in a minimum snow depth of 6 inches.

5.3.1 Method. Test participants will start at a staging area and march for approximately 30 minutes to a rifle range. Test participants will then perform a firing or simulated firing exercise and advance by crawling to a new position.

5.3.1.1 Prior to starting the test, all test items will be thoroughly dried and the weight of each item recorded. In a warm shelter (21°C, ±3°C) test participants will don the test item and the additional standard issue clothing appropriate to the prevailing weather conditions. The temperature of each thermocouple on each test participant shall be recorded prior to leaving the warm shelter and at 20-minute intervals thereafter during the test.

5.3.1.2 Test participants shall assemble in a rifle squad and march to the rifle range. The march shall be through existing snow a minimum of 6 inches deep.

5.3.1.3 Upon arrival at the rifle range, each test participant shall either fire or simulate the firing of 50 rounds of ammunition using the standard military rifle from the prone position. They will then crawl 50 meters to a new firing position and either fire or simulate the firing of 50 additional rounds from the prone position.

5.3.1.4 Test participants will then crawl 40 meters to a new firing position and either fire or simulate firing of 50 additional rounds from the prone position.

5.3.1.5 After completion of the firing, test participants will assemble into a squad and march for 30 minutes back to the staging area.

5.3.1.6 After reaching the staging area, the temperature of each thermocouple should be recorded (regardless of time since last temperature recording) and the test participants shall enter a heated shelter. The test items will be removed, weighed, and the weights recorded.

5.3.1.7 Test participants will then be interviewed (appendix C) to obtain an individual subjective assessment of the test item's resistance to snow penetration.

5.3.2 Data Required.

Meteorological condition
Weight of test items
Thermocouple temperature
Total time
Snow classification data (CRTC Memo 70-5)

5.4 Perspiration Absorption

5.4.1 Method The moisture absorption characteristics of the test item shall be assessed during four 2-hour tests. Two tests shall be conducted within 15°C of the lowest temperature the test item is to be worn, and two tests will be conducted between -3.9°C and 4.5°C. One test in each temperature range will be conducted with test participants marching at an average pace of 2½ miles per hour and one test will be conducted with test participants marching at an average pace of 4½ miles per hour. The test item shall be weighed before the test begans and immediately after the conclusion of the exercise to determine moisture uptake. Ventilation techniques used during the exercise shall be consistent for all test participants.

5.4.1.1 All test items shall be thoroughly dried and the item weighed and the weight recorded. Test participants will don the test item, and the additional clothing appropriate to the prevailing weather condition, in a warm shelter (21°C, ±3°C).

5.4.1.2 The test participants shall assemble at the test site free from snow and perform the applicable marching exercise described in paragraph 5.4.1.

5.4.1.3 At the conclusion of the 2-hour test period, test participants shall enter the warm shelter and remove the test items. The test items shall be weighed immediately and their weight recorded.

5.4.1.4 Data Required

Weight of test item (start)
Weight of test item (conclusion)
Type test and length
Meteorological conditions

5.5 Thermal Durability

5.5.1 Definition. Thermal durability is a quantitative measurement of the effects of wear and aging on the insulation characteristics of an item of protective clothing.

5.5.2 Method. Thermal durability shall be evaluated utilizing test participants comments and the data collection during conduct of this test.

5.5.2.1 Paragraph 5.1.1.1 "Active Test, Cold Protection" shall be conducted as soon after test item issue as possible. In addition to the test item, all test participants shall be wearing identical types and quantities of standard issue clothing. The test will be conducted in the lowest one-third of the lowest temperature for which the test item was developed. A thermograph will be used to obtain a thermogram, from four different directions, of each test participant at the beginning of each rest period, before consumption of any liquids and at the conclusion of the test exercise. The thermograph will be adjusted to obtain the maximum delineation of contrast on the thermograms. The temperature at each area on the thermogram will be noted. The ambient temperature at the time the thermogram was taken will be noted.

5.5.2.2 At approximately 30-day intervals and at the conclusion of testing, paragraph 5.1.1.1 will be repeated. Considering the prevailing weather conditions, these tests will be conducted as near the same ambient temperature as is practicable.

5.5.3 Data Required

Meteorological Data (MET team daily)
Temperature at test site (during conduct of para 5.1.1.1)
Clothing worn by test participants (during conduct of para 5.1.1.1)
Thermograph data
Length of time test item worn
Test participants' comments (daily)
Visual clothing inspection (daily)
Thermocouple temperature (during conduct of para 5.1.1.1)
Description of failures (type, size, location, time to failure, frequency, and cause if known)
Record of repairs

5.6 Physical Durability

5.6.1 A durability failure is considered to be a malfunction that precludes further use of the item and is significant enough in the area of cost, safety, environmental protection, or time to restore, that the item must be replaced or completely refurbished. Durability failures will be identified as to those caused by normal wear or those caused when using the obstacle course described in appendix D.

5.6.2 Method. The physical durability of the test item will be evaluated from failures experienced as a result of normal wear and this test. Failures will be identified as to those caused by normal wear and those caused by this test which incorporates the use of an obstacle course.

5.6.2.1 Approximately 14 days after test item issue, each test participant wearing the test item shall go through an obstacle course, twice (sketch 1, appendix D is an example of a typical course). Prior to and at the conclusion of this test, all test items shall be inspected for physical damage and wear. This inspection shall be performed while the test item is not being worn. Damaged or worn test items shall be photographed and a narrative description of the wear or damage recorded. All usable test items shall be returned to the test participants for completion of the test. Test items sustaining nonrepairable physical degradation will be disposed of in accordance with the instruction of the test directive or the test sponsor.

5.6.2.2 At the conclusion of each additional 14 days of testing repeat paragraph 5.6.2.1.

5.6.3 Data Required

Date of Issue
Record of Repairs
Photographs of damaged and unserviceable test items
Total time worn (usage time)
Number of repetitions through obstacle course
Description of durability failures (type, size, location, time to failure, and cause, if known)

5.7 Human Factors Evaluation

5.7.1 Conduct all human factors in accordance with applicable sections of TOP 1-2-611 (ref 4, appendix C).

5.7.2 Conduct this subtest concurrent with operational subtests in this TOP.

5.7.3 Determine if the item is compatible with the skills, aptitudes, and limitations of personnel who will operate and maintain it under cold regions winter environmental conditions.

5.7.4 Determine if test item and all its accessories and components enable easy operation by test personnel wearing the appropriate winter uniform.

5.7.5 Observe and record any major and minor tasks which are difficult or impossible to accomplish on or with the test item under cold regions winter environmental conditions.

5.8 Logistic Supportability. Classifications and definitions of malfunctions shall be as approved and defined by all USATECOM testing agencies.

5.8.1 Conduct all logistic supportability tests in accordance with applicable sections of TECOM Supplement 1 to DARCOM Regulation 700-15 (ref 5, appendix C).

5.8.2 Conduct this subtest concurrent with operational subtests in this TOP.

5.8.3 Evaluate spare parts requirements under cold regions environmental conditions and compare with all replacement parts and components provided with the test item.

5.8.4 Utilize all common and special tools and test equipment furnished with the test item.

5.8.5 Analyze all publications provided with the test items for clarity and simplicity of instructions and completeness of preventive maintenance procedures, especially those associated with operation in a cold regions environment.

5.8.6 Monitor all maintenance operations to determine if instructions and sequence of operations are adequate for the level of training of the maintenance personnel.

5.9 Safety

5.9.1 Conduct all safety tests in accordance with applicable sections of MTP 10-4-500 (ref 3, appendix C).

5.9.2 Conduct this subtest concurrent with operational subtests in this TOP.

5.9.3 Determine if the test item is safe for US Army use under cold regions environmental conditions.

5.9.4 Prepare an adequate safety SOP to provide safety for personnel and equipment and ensure that all safety SOP's are observed throughout the test. Be sure to obtain a safety release prior to test conduct.

6. DATA REDUCTION AND PRESENTATION.

6.1 Tabulate all data.

6.2 Cold Protection. Examine tabulated data at individual points in time. Average values from individuals for each thermocouple location. If comparing experimental to standard clothing, compare the average values and dispersions. Subjective comments from test participants, test supervisory personnel observations and interview data will be summarized. IR Scanner temperature data shall be correlated with the temperature data accumulated in the inactive phase of the test.

6.3 Wind Protection. Plot thermocouple temperature versus time for each thermocouple location. Values from different individuals will be plotted on a scatter diagram with a least squares curve fit for each thermocouple location (see example, appendix B). Subjective comments, as in para 6.2, will be summarized.

6.4 Snow Protection Data reduction performed as in para 6.2 except for IR scanner data. Snow classification data will be recorded. Net weight gains of clothing will be calculated.

6.5 Perspiration Absorption. Moisture uptake of the test items shall be calculated for each layer and presented in tabular form and correlated to the use of the test item. Comparative data for standard or comparison clothing will be listed.

6.6 Thermal Durability. The temperature data taken during thermal durability test will be tabulated for each thermocouple position. At the conclusion of testing the data will be analyzed to determine if a degradation trend exists. The thermograms from each test will be analyzed to evaluate insulation deterioration. Trends shall be categorized and described in narrative form.

6.7 Physical Durability. Repairs required on the test item will be categorized and presented in tabular form. Illustrative photographs with a narrative description of the failure will be included in the test data for all test items withdrawn from testing because of physical failures. Durability parameters will be evaluated from an analysis of the test data.

Recommended changes to this publication should be forwarded to Commander, US Army Test and Evaluation Command, ATTN: DRSTE-AD-M, Aberdeen Proving Ground, MD 21005. Technical information may be obtained from the preparing activity: Commander, US Army Cold Regions Test Center, ATTN: STECR-TD-DC, APO Seattle WA 98733. Additional copies are available from the Technical Information Center, Cameron Station, Alexandria, VA 22314. This document is identified by the accession number (AD No.) printed on the first page.

# APPENDIX A - CHECKLIST

1. Preparation for test

1.1 Facilities

( ) Heated shelter available.
( ) 110 vac, 60 Hz power available.
( ) Obstacle course available.
( ) 100-meter course established.

1.2 Instrumentation

( ) All instrumentation equipment available (ref para 2.2).
( ) All instrumentation calibrated as required.
( ) Training completed or operator available.

1.3 Test items

( ) Minimum number available for testing.
( ) Sizes of representative items.
( ) Physical characteristics recorded.
( ) Identification numbers applied.
( ) Cleaning schedules/methods established.
( ) Testing temperatures established.

1.4 Personnel

( ) Personnel data recorded.
( ) Physical examinations completed.
( ) Test items fitted to participants.
( ) Personnel briefed on use/applications.
( ) Personnel briefed on test objectives.
( ) Personnel briefed on test procedures.
( ) Personnel briefed on responsibilities.

2. Performance tests

2.1 Thermal durability (each 30 days)

( ) Paragraph 5.1.1.1 "Cold Protection" performed.
( ) Thermographs obtained for each test paticipant.
( ) Test performed at 30-day intervals.
( ) Data sheets completed.

2.2 Physical durability (each 14 days)

( ) Obstacle course performed.
( ) Damage and wear assessment completed.
( ) Data sheets completed.

## APPENDIX B - SAMPLE DATA SHEETS

The information required for evaluation of cold regions durability will be satisfied by completion of data required for performing the testing outlined in TOP 10-2-510 "Cold Regions Environmental Protection Test of Clothing" in addition to the appropriate submittal of Equipment Performance Reports (EPR's) and EPR summaries.

## SAMPLE DATA SHEETS

Test Date _____

Test Item (Name) _____

Test Item SN _____

Time Started _____

Test Participant (Name) _____

| Test Time | Temperature (°C) | | | | | | | | Windspeed | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ambient | Thermocouple Location | | | | | | | | | |
| Minutes | Outside | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Min | Max | Avg |
| 0 | | | | | | | | | | | |
| 20 | | | | | | | | | | | |
| 40 | | | | | | | | | | | |
| 60 | | | | | | | | | | | |
| 80 | | | | | | | | | | | |
| 100 | | | | | | | | | | | |
| 120 | | | | | | | | | | | |
| 140 | | | | | | | | | | | |
| 160 | | | | | | | | | | | |
| 180 | | | | | | | | | | | |
| 200 | | | | | | | | | | | |
| 220 | | | | | | | | | | | |
| 240 | | | | | | | | | | | |
| 260 | | | | | | | | | | | |
| 280 | | | | | | | | | | | |
| 300 | | | | | | | | | | | |

Thermocouple Location Chart

| Position | Location |
|---|---|
| 1 | _____ |
| 2 | _____ |
| 3 | _____ |
| 4 | _____ |
| 5 | _____ |
| 6 | _____ |
| 7 | _____ |

Sample Thermocouple Data Plots

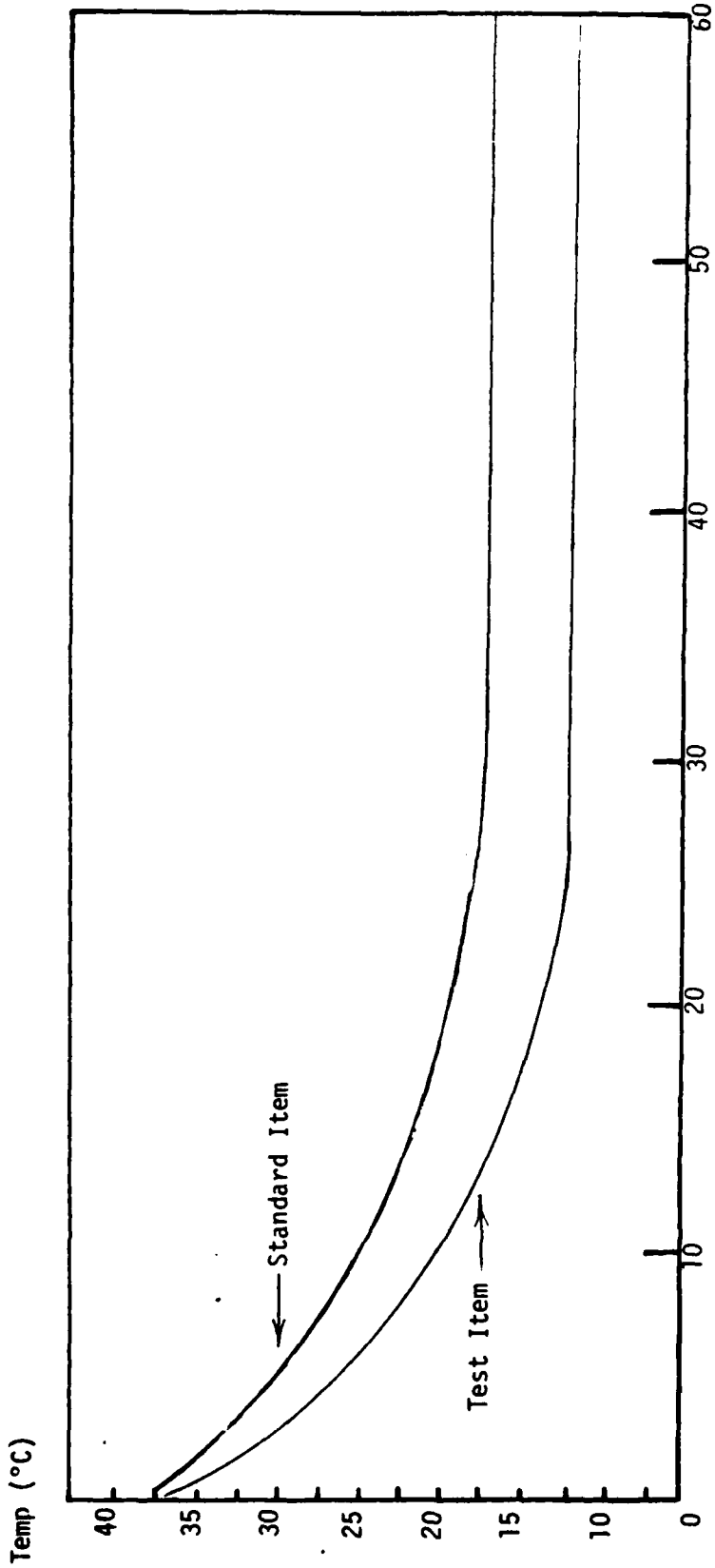



FIGURE XX - Mean Temperature at Chest Versus Time for Test Item Compared to Standard (Windchill -65°C)

## APPENDIX C - REFERENCES

1. TECOM Regulation 385-7, Potential Health Hazards to Humans Participating in Tests.

2. AR 70-25, Use of Volunteers as Subject of Research.

3. MTP 10-4-500, 25 June 1969, Arctic Preoperational Inspection, Physical Characteristics, Human Factors, Safety, and Maintenance Evaluation.

4. TOP 1-2-611, 20 January 1978, Cold Regions Human Factors Engineering.

5. TECOM Supplement 1, 20 June 1980 to DARCOM Regulation 700-15, 26 November 1979, Integrated Logistic Support.

## APPENDIX D - OPINION INTERVIEW*

1. a. How do you rate the fit of the clothing that you have worn?

_____6. Excellent

_____5. Very Good

_____4. Adequate

_____3. Not Quite Adequate

_____2. Poor

_____1. Extremely Poor

b. Comments: _____

_____

_____

2. a. How do you rate the freedom of movement afforded by the clothing?

_____6. Excellent

_____5. Very Good

_____4. Adequate

_____3. Not Quite Adequate

_____2. Poor

_____1. Extremely Poor

b. Comments: _____

_____

_____

*To be used in testing both the test and comparison items.

3. a. How do you rate the ability of the clothing you have worn to keep you warm on a windy day?

_____6. Excellent

_____5. Very Good

_____4. Adequate

_____3. Not Quite Adequate

_____2. Poor

_____1. Extremely Poor

b. Comments: _____

_____

_____

4. a. How do you rate the ability of the clothing you have worn to keep you warm on a calm day?

_____6. Excellent

_____5. Very Good

_____4. Adequate

_____3. Not Quite Adequate

_____2. Poor

_____1. Extremely Poor

b. Comments: _____

_____

_____

5. a. How do you rate the ventilation characteristics of the clothing that you have worn?

_____6. Excellent

_____5. Very Good

_____4. Adequate

_____3. Not Quite Adequate

_____2. Poor

_____1. Extremely Poor

b. Comments: _____

_____

_____

6. a. How do you rate the clothing you have worn for use by the Army?

_____6. Excellent

_____5. Very Good

_____4. Adequate

_____3. Not Quite Adequate

_____2. Poor

_____1. Extremely Poor

b. Comments: _____

_____

_____

7. a. How do you rate the fasteners, snaps, and zipper provided on the clothing that you have worn?

_____6. Excellent

_____5. Very Good

_____4. Adequate

_____3. Not Quite Adequate

_____2. Poor

_____1. Extremely Poor

b. Comments: _____

_____

_____

8. a. How do you rate the ease with which you were able to don the clothing?

_____6. Extremely Easy

_____5. Easy

_____4. Could be Easier

_____3. Difficult at Times

_____2. Difficult

_____1. Extremely Difficult

b. Comments: _____

_____

_____

9. a. How do you rate the ease with which you were able to doff the clothing?

_____6. Extremely Easy

_____5. Easy

_____4. Could be Easier

_____3. Difficult at Times

_____2. Difficult

_____1. Extremely Difficult

b. Comments: _____

_____

_____

10. a. Did you sweat excessively while wearing the clothing during outdoor exercises? YES _____ NO _____.

b. If yes, please explain: _____

_____

_____

11. a Did you experience any cold spots, numbness or shivering while wearing the clothing during outdoor exercises? YES _____ NO _____.

b. If yes, please explain: _____

_____

_____

12. a. While you were wearing the clothing, did snow or other foreign material get inside the clothing? YES _____ NO _____.

b. If yes, please explain: _____

_____

_____

13. a. Were you bothered by any of the following while you were wearing the clothing?

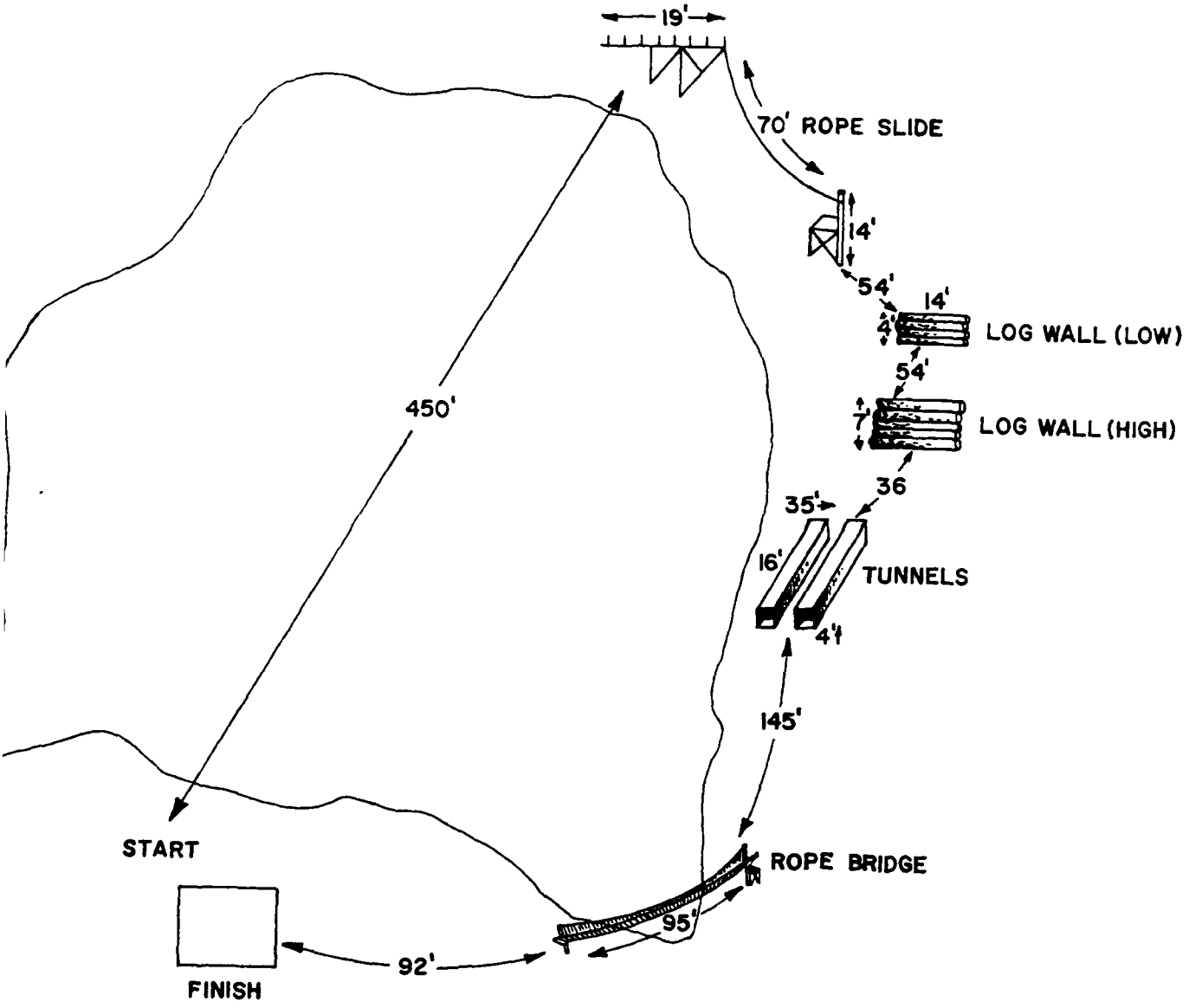
| YES | NO | |
|---|---|---|
| _____ | _____ | Fabric Noise |
| _____ | _____ | Static Electricity |
| _____ | _____ | Loose Flaps |
| _____ | _____ | Loose Cords |

b. If yes to any of the above, please explain: _____

_____

_____

## APPENDIX E - COLD REGIONS EQUIPMENT PERFORMANCE OBSTACLE COURSE



# APPENDIX F - WIND CHILL CHART

| WIND SPEED | | COOLING POWER OF WIND EXPRESSED AS "EQUIVALENT CHILL TEMPERATURE" | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KNOTS | MPH | TEMPERATURE (°F) | | | | | | | | | | | | | | | | | | | | |
| CALM | CALM | 40 | 35 | 30 | 25 | 20 | 15 | 10 | 5 | 0 | -5 | -10 | -15 | -20 | -25 | -30 | -35 | -40 | -45 | -50 | -55 | -60 |
| | | EQUIVALENT CHILL TEMPERATURE | | | | | | | | | | | | | | | | | | | | |
| 3 - 6 | 5 | 35 | 30 | 25 | 20 | 15 | 10 | 5 | 0 | -5 | -10 | -15 | -20 | -25 | -30 | -35 | -40 | -45 | -50 | -55 | -60 | -70 |
| 7 - 10 | 10 | 30 | 20 | 15 | 10 | 5 | 0 | -10 | -15 | -20 | -25 | -35 | -40 | -45 | -50 | -60 | -65 | -70 | -75 | -80 | -90 | -95 |
| 11 - 15 | 15 | 25 | 15 | 10 | 0 | -5 | -10 | -20 | -25 | -30 | -40 | -45 | -50 | -60 | -65 | -70 | -80 | -85 | -90 | -100 | -105 | -110 |
| 16 - 19 | 20 | 20 | 10 | 5 | 0 | -10 | -15 | -25 | -30 | -35 | -45 | -50 | -60 | -65 | -75 | -80 | -85 | -95 | -100 | -110 | -115 | -120 |
| 20-23 | 25 | 15 | 10 | 0 | -5 | -15 | -20 | -30 | -35 | -45 | -50 | -60 | -65 | -75 | -80 | -90 | -95 | -105 | -110 | -120 | -125 | -135 |
| 24-28 | 30 | 10 | 5 | 0 | -10 | -20 | -25 | -30 | -40 | -50 | -55 | -65 | -70 | -80 | -85 | -95 | -100 | -110 | -115 | -125 | -130 | -140 |
| 29-32 | 35 | 10 | 5 | -5 | -10 | -20 | -30 | -35 | -40 | -50 | -60 | -65 | -75 | -80 | -90 | -100 | -105 | -115 | -120 | -130 | -135 | -145 |
| 33-36 | 40 | 10 | 0 | -5 | -15 | -20 | -30 | -35 | -45 | -55 | -60 | -70 | -75 | -85 | -95 | -100 | -110 | -115 | -125 | -130 | -140 | -150 |
| WINDS ABOVE 40 HAVE LITTLE ADDITIONAL EFFECT | | LITTLE DANGER | | | | | INCREASING DANGER (Flesh may freeze within 1 minute) | | | | | | GREAT DANGER (Flesh may freeze within 30 secs) | | | | | | | | | |

| Degrees Fahrenheit | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Degrees Celsius | 0.56 | 1.11 | 1.67 | 2.22 | 2.78 | 3.33 | 3.89 | 4.44 | 5.00 |